WHAT IS CLAIMED IS:

1. A motion control system comprising control logic and a programming interface, the programming interface being configured to permit a user to specify a plurality of non-tangential path segments, and the control logic being configured to generate a plurality of additional transitioning path segments substantially extending between the non-tangential path segments, and wherein the control logic is configured to generate control signals to control operation of a plurality of motion axes to drive movement of a controlled element along a path defined by the non-tangential path segments and the additional transitioning path segments.

2. A system according to claim 1, wherein the control signals include position reference values and wherein the control logic includes a plurality of interpolators configured to generate the position reference values substantially simultaneously along a plurality of different coordinate axes.

3. A system according to claim 2, wherein the plurality of interpolators are configured to generate the position reference values approximately once per update cycle for each of the plurality of different coordinate axes.

4. A system according to claim 1, wherein each of the plurality of motion axes comprises a motor.

5. A system according to claim 1, wherein the plurality of path segments include a first path segment and a second path segment, wherein the first path segment and the second path segment are non-coplanar such that no plane exists which contains both the first path segment and the second path segment, and wherein the control logic is configured to generate a transitioning path segment that extends between the first path segment and the second path segment.

6. A system according to claim 1, wherein the plurality of non-tangential path segments are specified in a plurality of respective user instructions, and wherein each instruction contains fields to permit the user to separately specify

a maximum acceleration, maximum deceleration and maximum speed for the path segment.

7. A system according to claim 1, wherein the programming interface is configured to permit the user to specify the plurality of non-tangential path segments in a first coordinate system, wherein the plurality of motion axes comprise a plurality of motors, wherein the plurality of motors define a second coordinate system which is different than the first coordinate system, and wherein the control logic includes coordinate transformation logic configured to perform coordinate transformations between the first coordinate system and the second coordinate system.

8. A system according to claim 7, wherein the control logic includes control logic configured to generate position reference values for use in controlling the plurality of motors, the position reference values including a first set of position reference corresponding to a first axis of the first coordinate system and a second set of position reference values corresponding to a second axis of the first coordinate system, and wherein the coordinate transformation logic transforms the first and second sets of position reference values for use in the second coordinate system.

9. A system according to claim 1, wherein the programming interface includes an instruction which permits the commanded path profile to be changed dynamically from a first path profile to a second path profile while the first path profile is being executed before a user-specified endpoint of the first path profile is reached.

10. A system according to claim 1 wherein, during movement along the transitioning path segments, the controlled element transitions from the first user-specified path segment to the second user-specified path segment without spikes in acceleration.

11. A system according to claim 1, wherein the programming interface is an object-oriented programming interface in which displayable objects are used to represent physical hardware and relationships between physical hardware.

12. A system according to claim 1, wherein the programming interface includes a jog block which permits the user via a jog instruction to specify a new velocity at which a shaft of a motor, a move block which permits the user via a move instruction to specify a new position for a shaft of a motor, a time cam block which permits a user via a time cam instruction to specify an axis position profile which specifies axis position as a function of time, a gear cam block which permits the user via a gear instruction to specify an electronic gearing relationship between the shaft of a motor and a shaft of another motor, a position cam block which permits the user via a position cam instruction to specify an axis position profile which specifies axis position for a shaft of a motor as a function of a position of the shaft of another motor.

13. A system according to claim 1, wherein the system is an industrial control system.

14. A system according to claim 1,

wherein the programming interface permits the user to specify a merge type,

wherein, according to a first merge type, (1) any currently executing coordinated motion instructions involving the same specified coordinate system are terminated and prior motion is merged into the current move, and (2) any currently executing system single axis motion instructions involving any axes defined in the specified coordinate system are not affected, and

wherein, according to a second merge type, (1) any currently executing single axis motion instructions involving any axes defined in the specified coordinate system are terminated, (2) any currently executing coordinated motion instructions involving the same specified coordinate system are terminated, and (3) the prior motion is merged into the current move.

15. A control method for controlling movement of a controlled element in a multi-dimensional coordinate system, the multi-dimensional coordinate system being defined by at least first and second motion axes of a motion control system, comprising:

controlling movement of a controlled element along a first user-specified path segment, the first user-specified path segment being specified in one or more instructions in a user program;

controlling movement of the controlled element along a transition path segment, the transition path segment transitioning movement of the controlled element from a first trajectory along the first user-specified path segment to a second trajectory along a second user-specified path segment, the first and second trajectories having different orientations in the multi-dimensional coordinate system, and the transition path segment being generated by control logic and not being user-specified; and

controlling movement of the controlled element along the second user-specified path segment, the second user-specified path segment being specified by the one or more instructions in the user program.

16. A method according to claim 15 wherein, during movement along the transition path segment, the controlled element transitions from the first user-specified path segment to the second user-specified path segment without spikes in acceleration.

17. A method according to claim 15, wherein the first user-specified path segment and the second user-specified path segment are located in different planes of a three dimensional space.

18. A method according to claim 15, wherein the transition path segment has a shape which is a circular segment.

19. A motion control system for controlling movement of a controlled element, the movement of the controlled element being driven by first and second motors, comprising:

a first interpolator, the first interpolator generating a first set of position commands to control operation of the first and second motors, the first set of position commands being configured to control movement of the controlled element in a direction that is tangential to a trajectory of the controlled element throughout movement of the controlled element; and

a second interpolator, the second interpolator generating a second set of position commands to control operation of the first and second motors, the second set of position commands being configured to control movement of the controlled element in a direction that is non-tangential to the trajectory of the controlled element throughout movement of the controlled element.

20. A motion control system according to claim 19, wherein the first and second interpolators operate substantially simultaneously.

21. A motion control system according to claim 19, further comprising a third interpolator, and wherein the first, second, and third interpolators operate along orthogonal axes.

22. A motion control system according to claim 19,

wherein the motion control system includes a programming interface that permits the user to specify a merge type,

wherein, according to a first merge type, (1) any currently executing coordinated motion instructions involving the same specified coordinate system are terminated and prior motion is merged into the current move, and (2) any currently executing system single axis motion instructions involving any axes defined in the specified coordinate system are not affected, and

wherein, according to a second merge type, (1) any currently executing single axis motion instructions involving any axes defined in the specified coordinate system are terminated, (2) any currently executing coordinated motion instructions involving the same specified coordinate system are terminated, and (3) the prior motion is merged into the current move.

23. A motion control system for controlling three-dimensional movement of a controlled element, the movement of the controlled element being driven by first, second, and third motors, comprising:

a first interpolator, the first interpolator generating a first set of position commands to control operation of the first, second, and third motors, the first set of position commands being configured to control movement of the controlled element in a direction of a first vector; and

a second interpolator, the second interpolator generating a second set of position commands to control operation of the first, second, and third motors, the second set of position commands being configured to control movement of the controlled element in a direction of a second vector;

a third interpolator, the third interpolator generating a third set of set of position commands to control operation of the first, second, and third motors, the third set of position commands being configured to control movement of the controlled element in a direction of a third vector; and

coordinate transformation logic, the coordinate transformation logic being configured to transform the first, second and third sets of source system position commands from a source coordinate system defined by a trajectory of the controlled element to a target coordinate system defined by first, second, and third motion axes;

wherein one of the first, second, and third vectors is tangential to a trajectory of the controlled element throughout movement of the controlled element, and wherein the remaining ones of the first, second, and third vectors are normal to the trajectory of the controlled element and normal to each other throughout movement of the controlled element.

24. A system for controlling a first motor and a second motor, the first motor defining a first motion axis and the second motor defining a second motion axis; the system comprising motion control logic configured to control the first motor and the second motor in accordance with a user program, wherein the motion control logic provides a plurality of instructions configured for use in the user program, the plurality of instructions including an instruction that permits a move

to be specified in terms of a multi-dimensional coordinate system that includes the first motion axis and the second motion axis.

25. A programming interface for a motion control system, the programming interface including a multi-axis move instruction which allows a user to specify a move in multiple dimensions of a three dimensional source coordinate system, the multi-axis move instruction including one or more fields which permit the user to define a multi-dimensional path segment in the three-dimensional source coordinates system, and wherein the programming interface further includes coordinate transformation logic configured to transform move parameters generated in accordance with the move instruction into a target coordinate system, the target coordinate system being defined at least in part by first, second, and third motion axes.

26. An industrial control system comprising:

a plurality of input devices;

a plurality of output devices;

a communication network;

a plurality of motors;

a plurality of microprocessor-based controllers, the plurality of controllers being coupled to each other by way of the communication network, the plurality of controllers being coupled to respective ones of the plurality of input devices and the plurality of output devices, the plurality of controllers being configured to control the plurality of output devices based on input status information from the plurality of input devices, the plurality of microprocessor-based controllers including control logic to control the plurality of motors, and the plurality of controllers being configured to be programmed with a user program; and

a programming interface, the programming interface being configured to permit a user to generate the user program, the programming interface being configured to permit a user to specify a plurality of non-tangential path segments; and

wherein the control logic is configured to generate a plurality of additional transitioning path segments substantially extending between the non-tangential

path segments, and wherein the control logic is configured to generate control signals to control operation of motion axes to drive movement of a controlled element along a path defined by the non-tangential path segments and the additional transitioning path segments.